

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A transceiver, comprising:
 means for receiving a locally generated transmit signal;
 means for coupling the locally generated transmit signal to a communication medium, the means for coupling further coupled to a remotely generated receive signal;
 and
 means for recovering the remotely generated receive signal configured to reduce both short-term echo components and long-tail echo components of the locally generated transmit signal wherein the reduction of transmit signal echo is realized in a hybrid echo canceller.
2. The transceiver of claim 1, wherein the means for recovering comprises a multi-stage digital filter.
3. The transceiver of claim 2, further comprising:
 means for determining the length in taps of the digital filter required to reduce the short-term echo components; and
 means for bifurcating the multi-stage digital filter responsive to the determination means.
4. The transceiver of claim 2, wherein the multi-stage digital filter comprises a dual-stage finite impulse response (FIR) filter.
5. The transceiver of claim 2, wherein the multi-stage digital filter comprises a first stage that applies coefficients derived for each tap of the first stage and a second stage that derives coefficient values for a subset of the taps of the second stage.

1 6. The transceiver of claim 5, wherein the second stage applies a coefficient
2 value to each tap.

1 7. The transceiver of claim 5, wherein the second stage derives coefficient
2 values for each K^{th} tap.

1 8. The transceiver of claim 7, wherein the second stage uses an interpolation
2 scheme to determine coefficients to apply at each of the taps disposed between taps
3 associated with a derived coefficient.

1 9. The transceiver of claim 8, wherein the second stage applies a coefficient
2 value at taps disposed between derived coefficients as a function of a coefficient value for
3 the last derived coefficient.

1 10. The transceiver of claim 9, wherein the second stage applies the same
2 coefficient value at taps disposed between derived coefficients as the coefficient value for
3 the last derived coefficient.

1 11. A method for reducing transmit signal echo in a digital transceiver,
2 comprising:
3 bifurcating a digital filter in response to the conversion rate of the filter tap
4 coefficients;
5 adaptively calculating and applying a filter tap coefficient to each tap of a first
6 stage of the bifurcated digital filter;
7 adaptively calculating a subset of the filter tap coefficients of filter taps in the
8 second stage of the bifurcated filter; and
9 applying an interpolation technique to identify the remaining set of filter tap
10 coefficients of the second stage.

1 12. The method of claim 11, wherein the step of bifurcating the digital filter is
2 responsive to a digital subscriber line data transmission standard.

1 13. The method of claim 11, wherein the step of adaptively calculating a
2 subset of filter tap coefficients determines a filter tap coefficient for the first tap of the
3 second stage of the bifurcated filter and every K^{th} tap thereafter.

1 14. The method of claim 11, wherein the step of applying an interpolation
2 technique comprises determining a filter tap coefficient for each filter tap disposed
3 between calculated filter tap coefficients.

1 15. The method of claim 13, wherein the second stage applies a coefficient
2 value at taps disposed between adjacent adaptively calculated coefficients as a function of
3 the coefficient value associated with an earlier encountered tap.

1 16. The method of claim 13, wherein the second stage applies the same
2 coefficient value at taps disposed between adaptively calculated coefficients as the
3 coefficient value associated with an earlier encountered tap with a calculated coefficient.

1 17. A digital signal transceiver, comprising:
2 a transmitter configured to receive a locally generated transmit signal;
3 a hybrid electrically coupled to the transmitter configured to receive and
4 inductively couple the transmit signal to a two-wire transmission line, the hybrid further
5 configured to receive a remotely generated receive signal along the two-wire transmission
6 line;
7 a receiver configured to process the remotely generated receive signal; and
8 an echo canceller disposed in parallel between the transmitter and the receiver
9 configured to reduce both short-term echo components and long-tail echo components of
10 the locally generated transmit signal wherein the echo canceller calculates coefficient
11 values for less than N taps while emulating a N tap digital filter.

1 18. The transceiver of claim 17, wherein the echo canceller comprises a
2 bifurcated digital filter that adaptively calculates and applies tap coefficients to each of a
3 plurality of filter taps in a first stage and adaptively calculates and applies a subset of tap
4 coefficient values to a plurality of filter taps in a second stage.

1 19. The transceiver of claim 18, wherein the digital filter adaptively calculates
2 a tap coefficient value for a first tap of the second stage and every K^{th} tap thereafter.

1 20. The transceiver of claim 19, wherein the digital filter interpolates the
2 calculated tap coefficient values for the second stage to identify coefficient values to
3 apply at taps disposed between taps associated with a calculated tap coefficient.

1 21. A method for reducing transmit signal echo in a digital transceiver,
2 comprising:
3 means for bifurcating a digital filter in response to the conversion rate of the filter
4 tap coefficients;
5 means for deriving and applying a filter tap coefficient to each tap of a first stage
6 of the digital filter;
7 means for adapting a subset of coefficients each associated with a particular filter
8 tap in the second stage of the filter, the subset of coefficients comprising less coefficients
9 than the number of filter taps in the second stage of the filter; and
10 means for interpolating at least one coefficient value intended for application at a
11 filter tap not associated with an adapted coefficient of the second stage of the filter.

1 22. The method of claim 21, wherein the means for bifurcating is responsive
2 to a digital subscriber line data transmission standard.

1 23. The method of claim 21, wherein the means for adapting a subset of
2 coefficients determines a filter tap coefficient for a first tap of the second stage of the
3 bifurcated filter and every K^{th} tap thereafter.

1 24. The method of claim 21, wherein the means for interpolating comprises
2 determining a filter tap coefficient for each filter tap disposed between adapted filter tap
3 coefficients.

1 25. The method of claim 23, wherein the second stage of the filter applies a
2 coefficient value at filter taps disposed between K^{th} adapted filter taps as a function of the
3 coefficient value associated with an earlier encountered tap.

- 1 26. The method of claim 23, wherein the second stage of the filter applies the
- 2 same coefficient value at taps disposed between K^{th} adapted filter taps as the coefficient
- 3 value associated with an earlier encountered tap with an adapted coefficient.

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